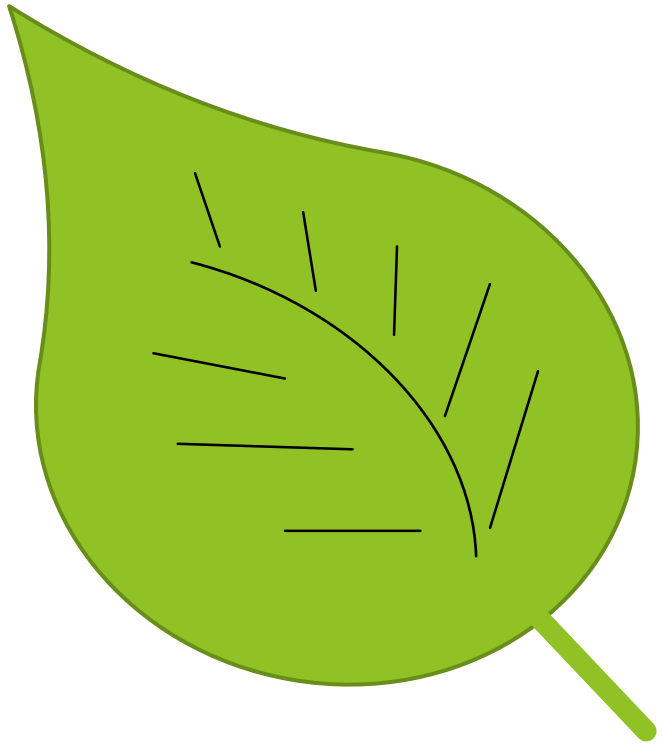
Soil and Crop Responses to Foliar Phosphorus Application

S. Froese and J. Schoenau
Department of Soil Science
University of Saskatchewan

Context

- Increasing P usage in Saskatchewan
- Placement and limitations
- Industry promotion

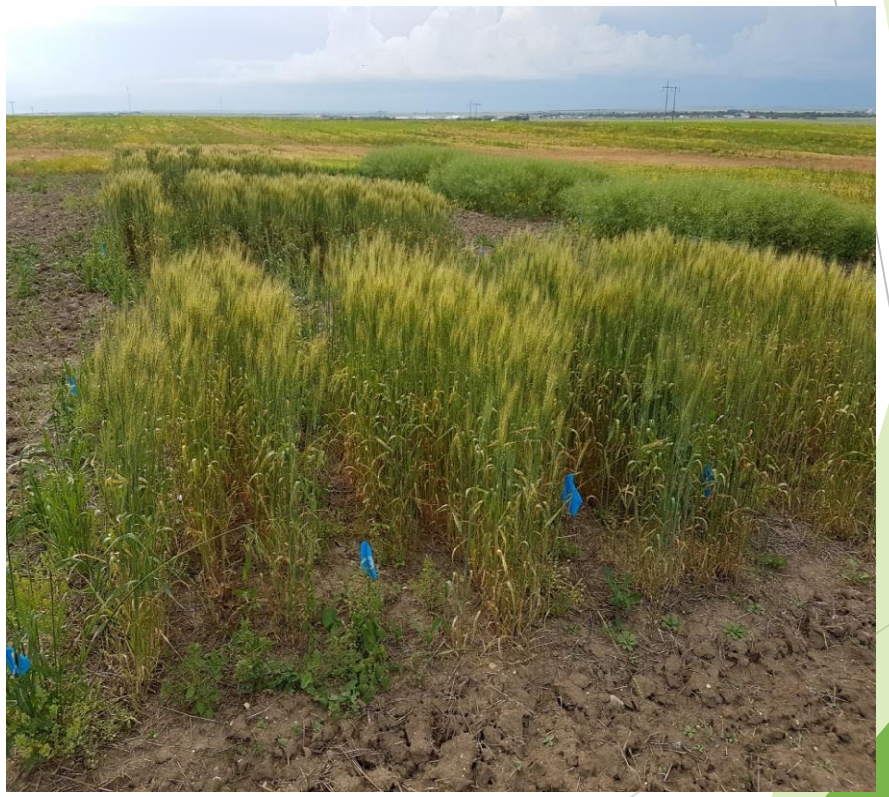


?

Objective

Determine the effect of foliar applied phosphorus on pea, wheat and canola crop response (yield, nutrient content and uptake) in contrasting soils in Saskatchewan over two years.

This presentation covers my 2016 results



2016 Pre-Seed Soil Sampling

Table 1. Soil association, extractable P, pH and OC from 0-15 cm depth at the four 2016 field research sites

Site	Association	MK-extractable P (mgP/kg) 0-15 cm	pH (0-15 cm)	% Organic C (0-15 cm)
Central Butte	Echo	11	7.9	1.1
Rosetown	Sutherland-Weyburn	12	8.1	1.7
Pilger	Krydor	7	7.9	4.4
St Brieux (Flooded)	Waitville	21	8.0	3.3

*MK-extractable P was analyzed by ALS labs in Saskatoon SK.

Study Treatments

Treatment	Control	Seed Placed	Low Foliar	Split App	High Foliar
			kg P_2O_5/ha		
Seed-Placed MAP	0	20	15	10	0
Foliar MKP	0	0	5	10	20
Total P	0	20	20	20	20

Foliar P Application

Table 1. Liquid foliar P treatment table

Rate	Water Volume		Concentration
kg P2O5/ha	L/ac	mL/plot	g/L
5	43.5	13.1	115
10	43.5	13.1	230
20	87	26.1	230

Phosphorus source is potassium phosphate dissolved in water.

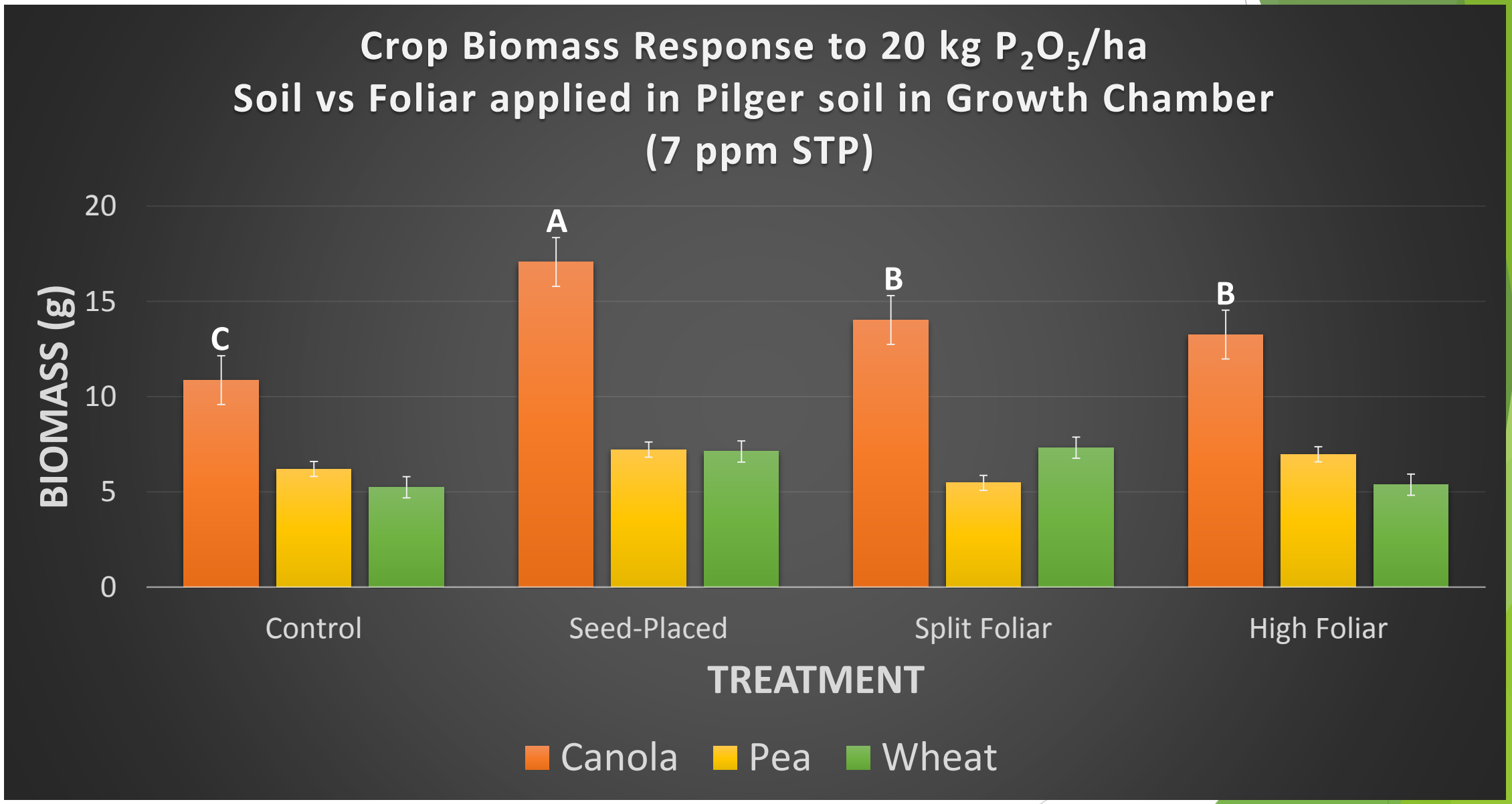
Commercial adjuvant "Xiameter" is added at 0.125 % volume.

Plot area is 0.0003 ac

MPK:
51.5% P2O5
34.0% K2O

RESULTS

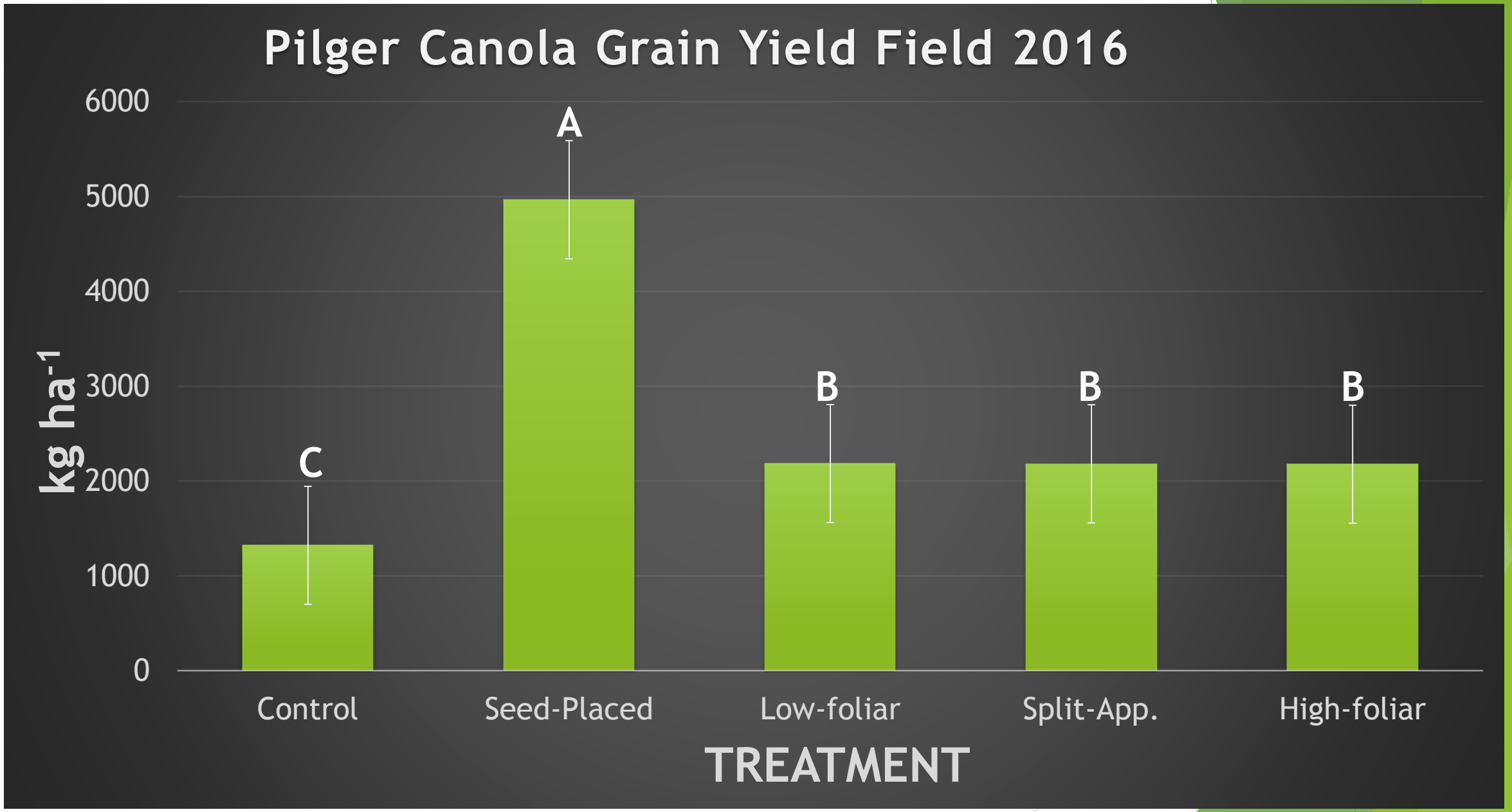
Controlled Environment Studies

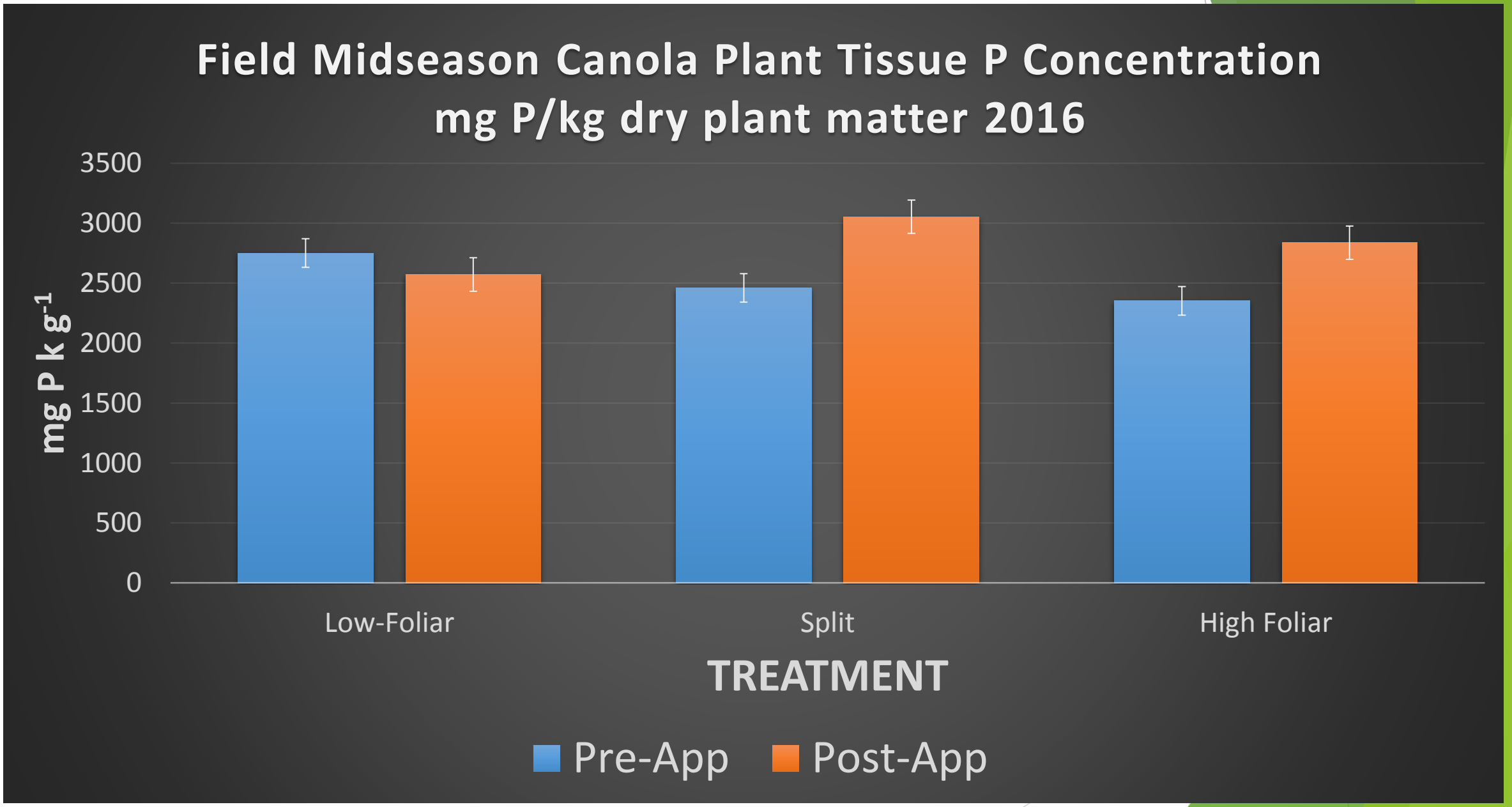


- Responsiveness to P fertilization: canola>wheat>pea.

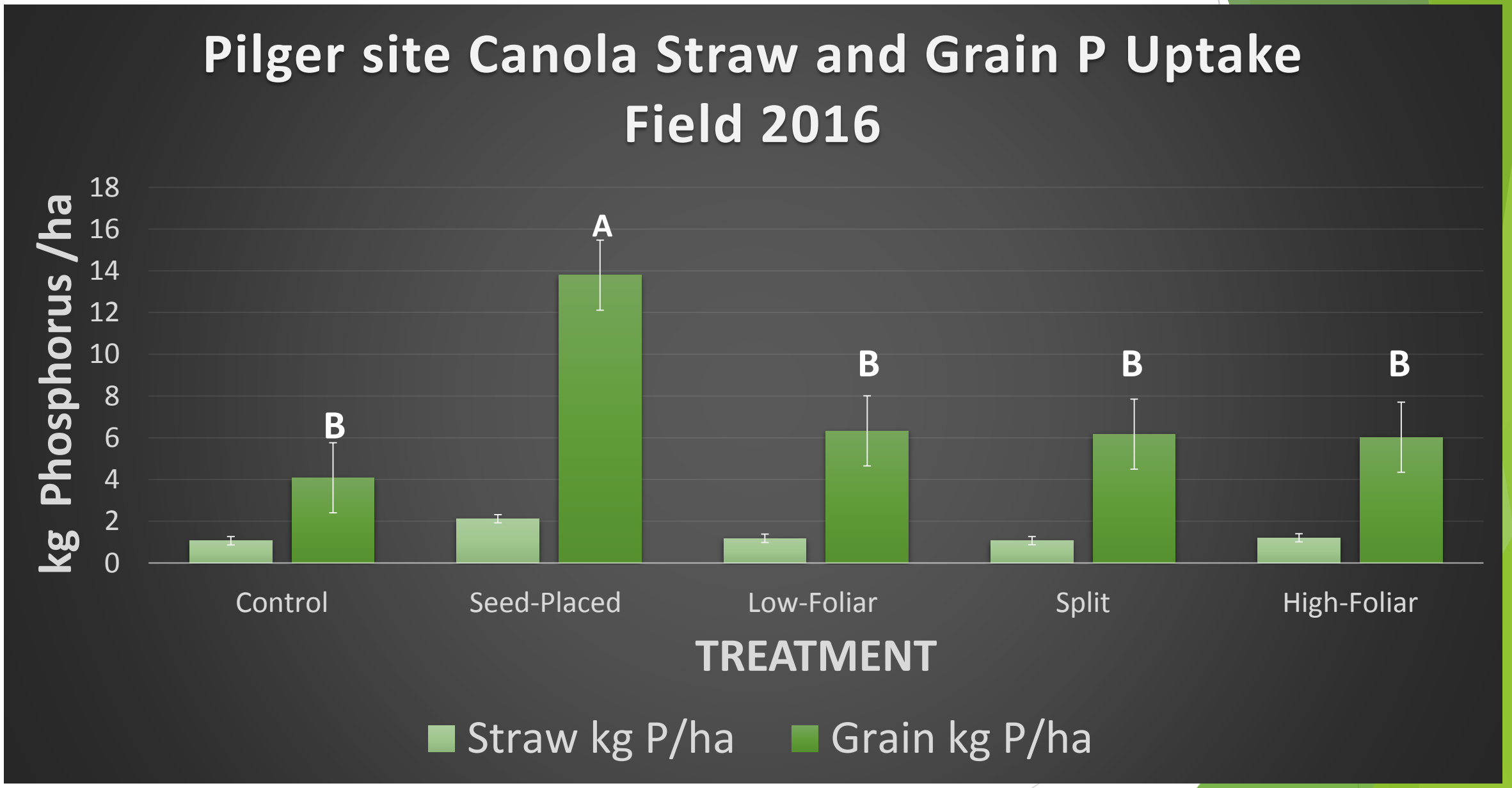
- Response to 20 kg P_2O_5/ha diminished as proportion of P applied as foliar increased.
  - limit to how much P can enter plant through leaf.

Taking it to the field……

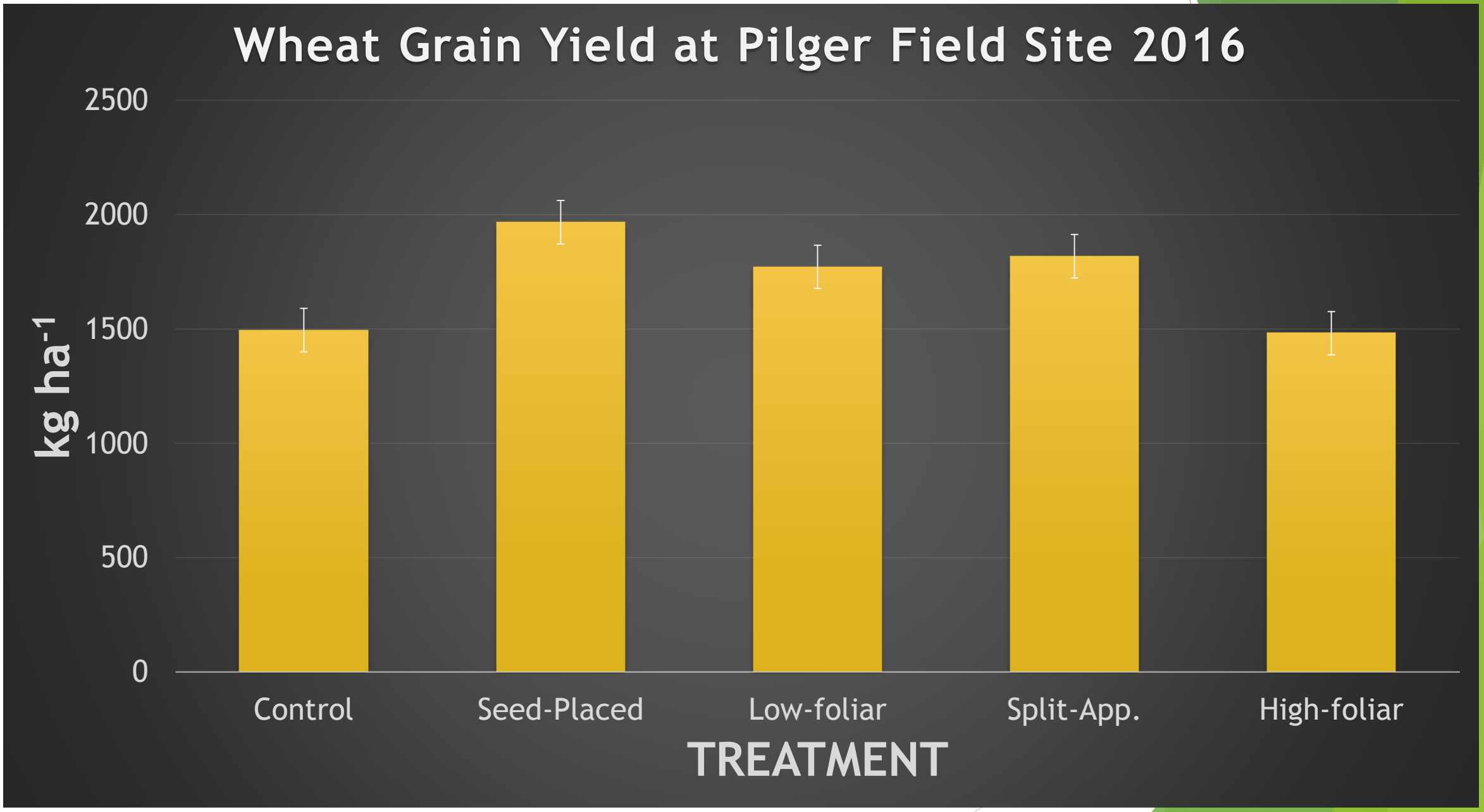

Pilger Canola Grain Yield Field 2016
6000
5000
4000
3000
2000
1000
0
kg ha-1
A
B
B
B
C
Control
Seed-Placed
Low-foliar
Split-App.
High-foliar
TREATMENT


Field Midseason Canola Plant Tissue P Concentration
mg P/kg dry plant matter 2016
3500
3000
2500
2000
1500
1000
500
0
mg P k g-1
Low-Foliar
Split
High Foliar
TREATMENT
Pre-App
Post-App

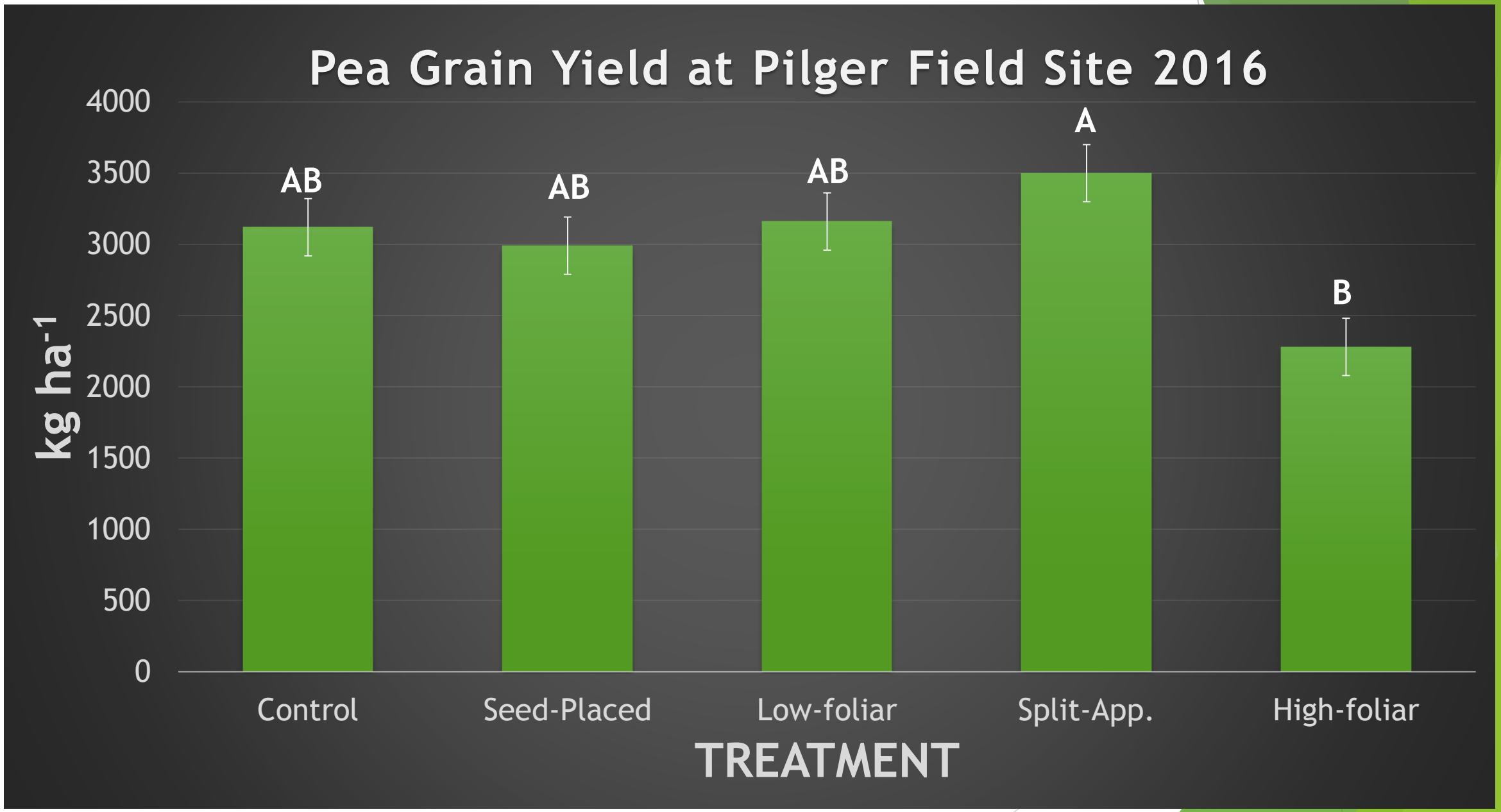
- Increase in tissue P concentration one week after foliar application suggests some P is entering plant.

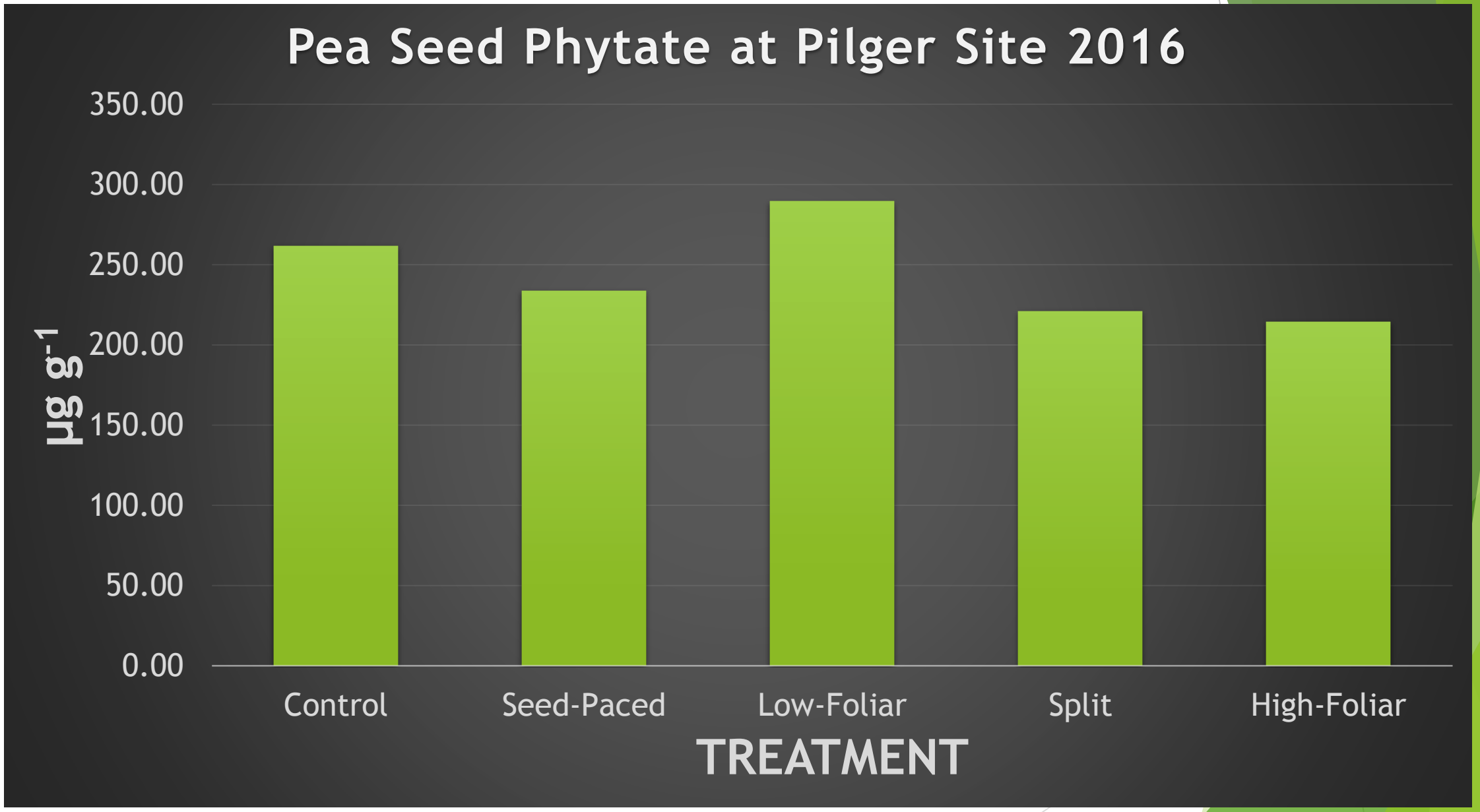

Pilger site Canola Straw and Grain P Uptake
Field 2016
kg Phosphorus /ha
18
16
14
12
10
8
6
4
2
0
A
B
B
B
B
Control
Seed-Placed
Low-Foliar
Split
High-Foliar
TREATMENT
Straw kg P/ha
Grain kg P/ha

- Most of above - ground P in canola grain.
- Seed-placed P resulted in highest above-ground P uptake by the canola.

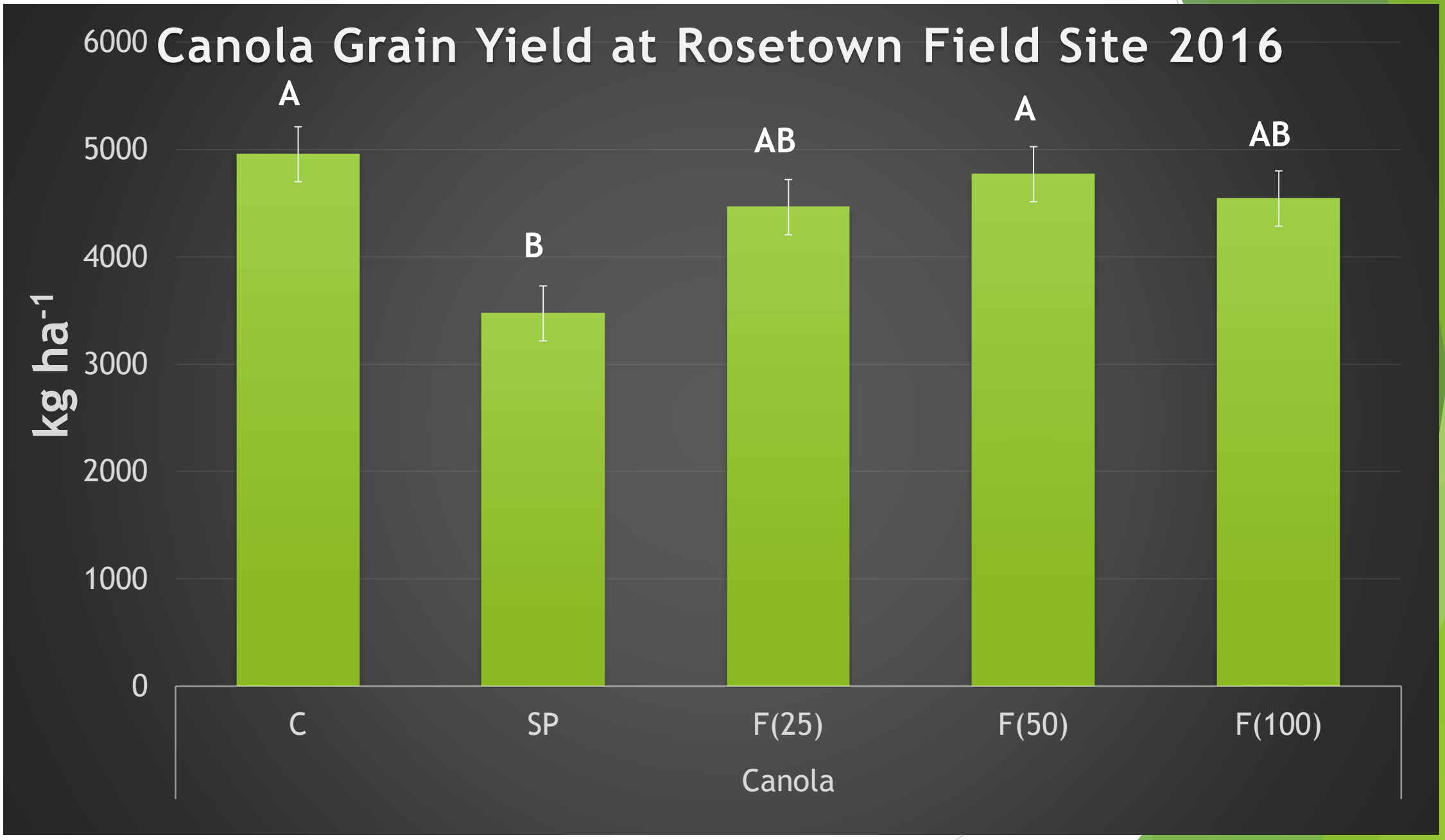

Wheat Grain Yield at Pilger Field Site 2016
2500
2000
1500
1000
500
0
kg ha-1
Control
Seed-Placed
Low-foliar
Split-App.
High-foliar
TREATMENT

- Wheat yield highest with all P seed-placed, lowest with all P foliar-applied.


Pea Grain Yield at Pilger Field Site 2016
4000
3500
3000
2500
2000
1500
1000
500
0
kg ha-1
AB
AB
AB
A
B
Control
Seed-Placed
Low-foliar
Split-App.
High-foliar
TREATMENT


Pea Seed Phytate at Pilger Site 2016
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
µg g-1
Control
Seed-Paced
Low-Foliar
Split
High-Foliar
TREATMENT

- Pea not responsive to P fertilization at Pilger field site compared to canola or wheat.
- Reduced pea yield with all P (20 kg P_2O_5/ha) applied as foliar spray: injury?


Canola Grain Yield at Rosetown Field Site 2016
6000
5000
4000
3000
2000
1000
0
kg ha-1
A
B
AB
A
AB
C
SP
F(25)
F(50)
F(100)
Canola

- Lack of positive response to P fertilization at Rosetown field site consistent with higher soil P fertility
- Reduced yield with all P (20 kg P_2O_5/ha) applied in seed-row: injury?

Key findings to date

- Response to P fertilization on soils < 10 mg P kg^{-1} MK P
- Response: Canola > Wheat > Pea (not responsive to P fert)
- Increasing proportion of P applied in foliar form resulted in lower yield response, but uptake maintained to a degree

Some uptake through leaves but not a substitute for soil application

Top up ???????

Acknowledgments

- Team Schoenau
  - Cory, Ranjan, Ben, Jordan, Lindsey, Paul, Serena, Tom, Ryan, Jing, Noabur, Nancy, Katya, Wally, Raul, Colin
- Advisory Committee: Drs. Schoenau, Knight and Warkentin
- Morgan Jaster
- Funding Agencies

  ADF, Sask Canola, Sask Wheat, Sask. Pulse Growers

Questions